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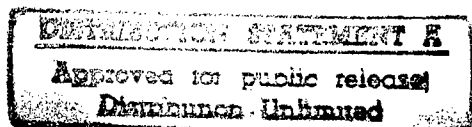
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CONFERENCE ON ELECTRON ACCELERATORS

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CONFERENCE ON ELECTRON ACCELERATORS

[Following is a translation of an article by V.N. Timov in Izvestiya Vysshikh Uchebnykh Zavedeniy-- Fizika (News of the Higher Educational Institutions, Physics) No. 1, Tomsk, Feb. 1960, pages 241-243.]

A national interuniversity scientific conference devoted to the problem "Electron Accelerators and Their Practical Application" was held at Tomsk Polytechnical Institute (TPI) at the beginning of September 1959.

This conference, like those convened in Tomsk in 1955 and 1958, attracted the attention of associates of many higher educational institutions, scientific-research and medical establishments, institutes of the Academy of Sciences USSR and industrial organizations. Upwards of 150 reports were presented to conference participants for discussion.

Read at the first plenary session was the report of A.A.Vorob'yev, a TPI professor, on the state of research in electron accelerators and proposals for their development. In his communication, A.A.Vorob'yev examined in

detail the modern state of engineering in electron acceleration and ways of further improvement. The advantages and shortcomings were discussed of the coherent method of acceleration, the stabilized electron beam method, accelerators with permanent magnetic field and various waveguide accelerators recently proposed.

Moscow State University (MGU) professor, A.A. Sokolov, spoke on "The Problem of Preserving Parity."

The first and, so far, only betatron in the Soviet Union, made at TPI with energy emission reaching 25 Mev, was installed in 1955 at Tomsk Medical Institute (TMI) for experimental and practical studies in the field of the effect hard roentgen irradiation has on the living organism. The first findings of this research were reported to the plenary session by G.P. Garganeyev, a candidate of medical sciences and an associate of TMI.

Subsequently, conference participants continued their discussion in five sections.

Problems of the physics of accelerators were discussed at the meetings of the theoretical section. Great interest was aroused by the reports of MGU associates, Prof. A.A. Sokolov and I.M. Ternov, entitled "Effect of Quantum Fluctuations on the Travel of Electrons in Cyclic Accelerators" and of A.N. Matveyev entitled "Effect

Electron Losses through Scattering Has on Residual Gas in Synchrotrons." In the latter report are cited the results of calculations of electron losses in the residual gas in synchrotrons, that were made by means of high-speed electronic computers. The results derived make it possible to evaluate swiftly, by means of elementary operations, the magnitude of the loss of electrons for arbitrary conditions of acceleration in synchrotrons with energies of electron injection above 50 kv.

The reviewed reports on the theory of the capture of electrons in acceleration and the experimental studies made in electron capture permit drawing the conclusion that there is at present the possibility of forming a sufficiently complete theory of the capture of electrons in acceleration in betatron conditions.

The general lagging of experimental studies in electron accelerator research and of experiments with accelerated electrons because of delays in putting powerful electron accelerators into operation should at the same time be noted, as the possibility is lacking to verify conclusions of theory swiftly and thereby hasten the general progress of science in this field.

In the section called "Cyclical Electron Accelerators", more than 50 reports were presented for

discussion. TPI associates reported about construction of an industrial model betatron of new type with energy of emission reading 30 Mev. The betatron can find wide application in industry and medicine. Betatron units with slewing of the radiation beam in space have special value. At the conference in 1958, the TPI research associates reported on the development of a betatron design with a freely moving beam. The design of betatrons with slewing of the radiation beam has also been developed at the designing department of the Moscow transformer factory.

Yu.M.Akimov and V.A.Moskalev (TPI) reported on a new design of two-chamber betatron. The stereobetatron makes it possible to get stereograms, which is extremely important in defectoscopy and in medicine in case of deep therapy of malignant tumors; bipolar irradiation halves the treatment time and reduces the dose received by surface tissues. A number of physical investigations can be made by means of a stereobetatron, in particular the study of the interaction of electrons in opposite beams.

The stereobetatron was displayed at the Soviet Exhibition in New York in 1959.

The reports read for discussion in the section were in considerable number devoted to problems of improving separate units of accelerators. G.A.

Kabanov, Ye.M.Belov, V.N.Titov (TPI) examined the very important question of the stabilization of the intensity of gamma radiation of betatrons. In case of substantial variations of voltage in the network feeding the electric energy unit, there is the possibility of stabilizing the output of irradiation doses with an accuracy of the order of $\pm 1\%$. An ordinary roentgenometer or photoelectron multiplier can be used in the capacity of pickup.

Original devices for measurement of magnetic field characteristics are described in the reports of V.S. Shirchenko (Physics Institute of the Academy of Sciences USSR), V.N.Yeponeshnikov, V.P.Kirillov and V.N.Kuz'min (TPI).

It should be noted that many years of research work has resulted in the development of model electron accelerators, betatrons, which fully meet the requirements of industry in work-piece defectoscopy and in medicine. The manufacture of sealed-off chambers has been mastered. The lead out of a beam of accelerated electrons from the betatron chamber has been realized.

It is to be regretted that the organizations which are engaged in developing electron accelerators with strong focusing and stabilizing of electron beams did not present reports for the discussion of conference participants.

In the Soviet Union two organizations, TPI and

the Designing Department of the Moscow Transformer Factory (MTZ), are engaged in working out designs of betatrons with emission energy reaching 20 to 30 Mev. It should be noted that while MTZ was represented by delegates at the conference, the MTZ associates could not offer reports for discussion at the conference.

In the course of the exchange of views, the participants in the section work came to the unanimous opinion that substantial work in development of modern designs of electron accelerators, betatrons, ^{had been done} during the period between the second (February 1958) and third interuniversity conferences.

At the section on "Highvoltage and Waveguide Accelerators", 15 reports were made. TPI research associate A.F. Kalganov spoke about a new type of electrostatic generator of the rotary model. These generators while having the capacity to create constant voltages in hundreds of kilovolts, are at the same time small in volume and weight. The unit can find wide application for feeding ^a neutron generator in industrial geophysics in connection with the exploration of oil wells.

V.V. Rumyantsev (Leningrad) and A.N. Fisun (Kharkov) gave interesting reports on electron linear accelerators with travelling wave at energies from 5 to 30 —

35 Mev. The first report told about development of serial type electronic accelerators for application in industry and medicine.

In the report of B.N.Morozov and Ye.V.Padusova (TPI) entitled "Dispersion Properties of Bent Diaphragm-Type Waveguides of Rectangular Cross Section," two methods were examined for retarding electromagnetic waves in evenly bent waveguides of rectangular cross section. The results obtained can be put at the basis of rating the system of waveguide cyclical electron accelerators to a travelling wave.

The classification of cophased waves in diaphragm-like waveguides of rectangular cross section was examined in the communication of Ye.S.Kovalenko (TPI). Critical frequencies of longitudinal magnetic waves are given as functions of waveguide dimensions.

The reports of A.M.Shenderovich (The Ukrainian Scientific Research Institute of Physics and Technology, Kharkov) entitled "Investigation of Reliability of Air Spark Discharger for Commutation of Large Pulse Currents" and "Development of New Types of Controlled Dischargers" were heard with interest.

Section participants submitted the proposal to recommend linear electron accelerators with travelling

wave for further development and serial production.

Most interesting and numerous were the meetings of the section on the application of electron accelerators in industry, medicine, biology and physics.

A series of extremely interesting scientific research studies carried out under the direction of Academician A.G.Savinykh, Prof. I.V.Toroptsev, Prof.K.N. Zivert and others has demonstrated that it is possible to utilize betatron radiation for treatment of malignant neoplasms (cancer, sarcoma).

TMI docent A.V.Borozdin^B gave the results of the treatment of three patients suffering from cancer of the tonsils, cancer of nasopharynx and lymphosarcoma of the tonsils. All patients were not subject to operation. The disease was in the third clinical stage. As a result of treatment, the tumors disappeared in all patients. Complete recovery set in, confirmed by histological examinations.

M.P.Lisovskaya (TMI) acquainted conferees with the results of treating neoplasms of the larynx. Seven patients with cancer of larynx were subjected to treatment. In virtually all cases a good clinical effect was recorded. The tumors were diminished, mobility of the larynx was increased, the voice appeared.

Prof.B.S.Poyzner (TMI), G.T.Ishchenko (TMI), N. D.Gerasimova (TMI) spoke about the cure of a number of patients who had suffered from cancer of the bladder and genital organs.

A.D.Proshina (TMI) touched upon interesting aspects of the influence of ionizing radiation: among descendents having an irradiated male parent, the number of descendents is reduced, stillbirth is increased, weight is diminished and life shortened.

The youngest conference participant, L.F.Boginich, a girl student of course IV at TMI, reported to the conference on the variation of the content of beta-lysine and lozitsin in the blood serum of animals, irradiated by the betatron. Practically the author raised a question not yet touched upon in the literature.

Academician A.G.Savinykh, Prof.I.V.Toroptsev, B.S.Poyzner and others took part in the discussion of the reports.

The findings of clinical materials were discussed at this conference in distinction from preceding ones at which the treatment of neoplasms was discussed in theory and the reports made bore an experimental character.

Scholars of Tomsk State University (TGU) told about investigations of the electrophysical properties

of certain materials. In the discussion of the reports was noted the actuality of the investigations made, critical comments were expressed on the method of irradiating specimens of the materials and recommendations made to expand the research after including in the study theme not only electrophysical but physicochemical properties of the substances as well.

The reports of associates of the All-Union Scientific Research Institute of Geophysics were devoted to problems of the application of charged particle accelerators in geophysical explorations in the ore and oil industries. Radiometric methods of exploring geological sections of drill holes are successfully applied at present in industrial geophysics. It is at the same time possible to get such valuable information about permeable bores of rocks as their porosity, oil-gas saturation, content of ores and coal in the rocks.

At the TPI laboratories the technical project of a small dimensional betatron has been elaborated, a betatron that it will be possible to lower into an industrial bore hole. A small dimensional source of high voltage has been developed for supplying a well generator of neutrons.

In its decisions the conference noted the definite achievements of scientific research institutions of the

Soviet Union in the field of theory elaboration, design developments and experimental research in electron accelerators. Noted at the same time was the insufficient attention on the part of the respective competent organs to the development and practical application of electron accelerators.

The conference decided to ask the State Scientific Technical Committee of the Council of Ministers USSR to decide the problem of wider installation of electron accelerators in the country's national economy, to organize business trips of scientists and engineers abroad for the purpose of becoming acquainted with the experience of foreign acceleration engineering and its practical application.

The reports made at the conference will be published in the form of conference transactions by the Tomsk State University press.

It was decided to convene the next, ^{the} 4th, interuniversity conference on electron accelerators in the city of Tomsk in February 1962.

Tomsk Polytechnical Institute imeni S.M.Kirov.

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